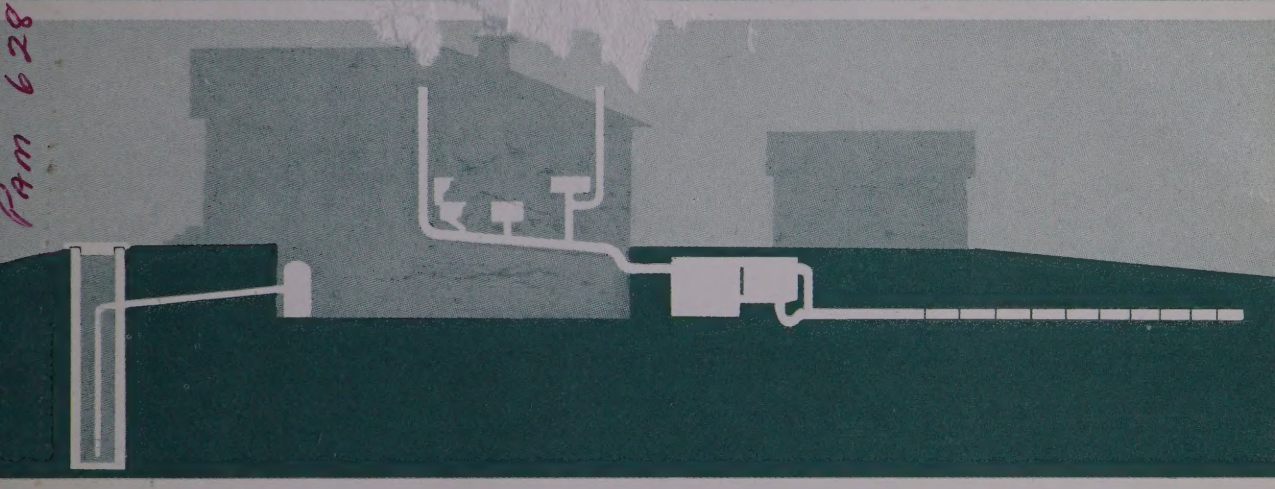

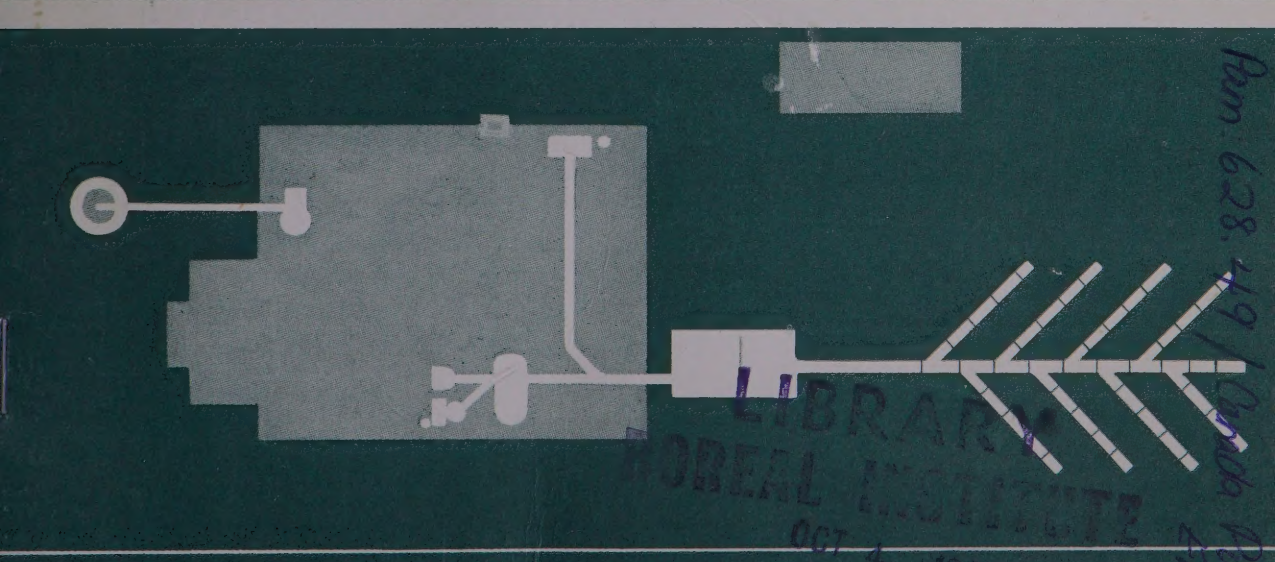

DOMESTIC SEWAGE DISPOSAL

DOMESTIC SEWAGE DISPOSAL

PUBLIC HEALTH ENGINEERING DIVISION
DEPARTMENT OF NATIONAL HEALTH AND WELFARE
CANADA

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DOMESTIC SEWAGE DISPOSAL

INTRODUCTION

The safe disposal of human excreta has always been a problem. Prior to the discovery of bacteria it was suspected that disease might be transmitted to humans by water which had been contaminated by human wastes. This was later confirmed through the knowledge of how disease is transmitted.

The science of bacteriology revealed that pathogenic (disease-producing) bacteria are excreted in the body discharges of man and animals, particularly by persons suffering from intestinal diseases and also from "carriers" who harbor the bacteria although they are not actually sick themselves.

Improper or inadequate disposal of human excreta has been the cause of many epidemics which have brought illness or death to large numbers of people. However, with improved methods of sanitation and greater public interest in disease control, the magnitude and frequency of epidemics of this nature have been greatly reduced. Nevertheless, the increased pollution of our streams and lakes resulting from growing population and expanding industry, with sporadic occurrences of water-borne outbreaks of typhoid fever, paratyphoid fever and dysentery, emphasizes the need for constant care.

In urban communities sewage disposal is the responsibility of the municipality. In rural or unsewered areas, the proper disposal of sewage becomes the responsibility of the individual householder.

With the rapid expansion of urban communities it has not always been possible to provide water supply and sewerage facilities to all sections. In some instances it may be several years before water mains and sewers can be constructed in the "fringe" areas. Consequently water must be obtained locally, the usual source being wells, and local arrangements must be made for the disposal of human wastes. These same problems occur in rural areas and require similar attention.

Because the disposal of excreta is a health problem, most health departments have regulations or requirements with which the home-owner should be familiar before planning any installation. Since conditions vary a good deal from province to province, basic requirements may differ, so information should be sought from the local or provincial health departments before planning or installing waste disposal equipment. Usually, informational pamphlets and suggested plans are available on request.

Similar problems are encountered on properties under federal control and this pamphlet presents basic information which will be helpful in planning and constructing sanitary facilities.

Methods of waste disposal are dependent on the availability of water. Where the water supply source is a well, and there is no provision for distributing the water under pressure, excreta disposal must be by some simple means, such as an outside toilet, chemical toilet or septic toilet.

OUTSIDE TOILET

The outside toilet, popularly known in Canada as a "privy", is still used extensively and, while it is not a very satisfactory method of disposal, it can be employed without serious danger to health if certain precautions are observed.

One of the commonest types of construction is the pit privy. The privy is constructed over an excavation, which is usually large enough to take care of wastes for a period of several years. The pit should be sheathed on the sides to prevent caving and it is desirable to raise the ground elevation around the pit to prevent the entry of surface water.

Special care should be observed in locating the excavation so that drainage from it will not contaminate any wells in the vicinity. The safe distance between a privy pit and a well can only be determined with a thorough knowledge of underground conditions. If the soil is impervious clay, a short distance between the privy pit and well may be quite satisfactory. Sand, sandy loam or clay loam will require a greater distance while gravel or fissured rock may provide channels through which wastes may travel considerable distances. In such cases, it may be necessary to construct a watertight pit which will retain all wastes. Strict adherence to provincial regulations or recommended standards of the National Building Code governing recommended minimum distances is essential.

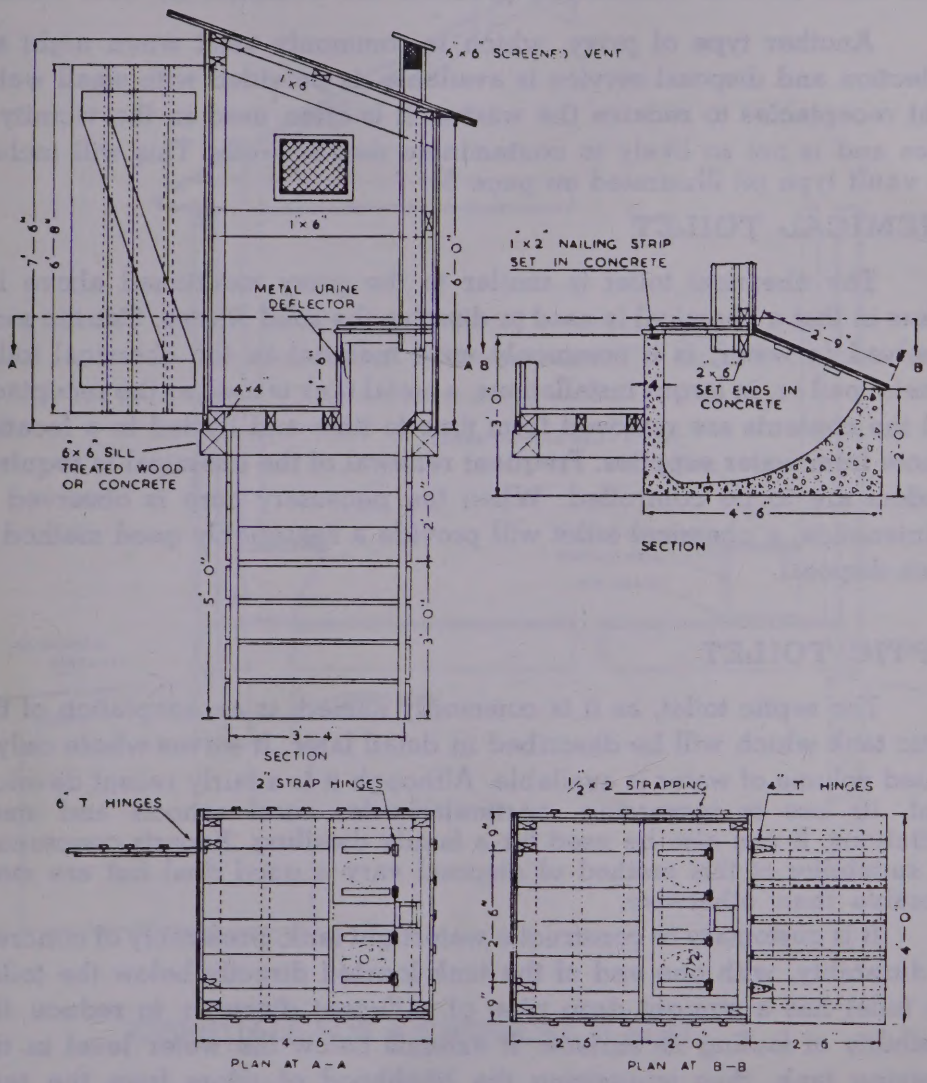
Care should be observed in locating the privy at a lower elevation than the well.

The distance between an earth pit privy and a well, as recommended by the governing authority, usually varies from fifty feet to one hundred feet.

Certain precautions are required in relation to the privy itself. The basic requirement is that insects and animals should not have access to the wastes since they may transmit pathogenic bacteria to food supplies. By reason of its filthy habits, the house fly must be excluded from the privy, especially the pit. All openings in the privy building should be screened. Matched dry lumber or board and batten construction should be used, otherwise there will likely be numerous small openings. The door should be self-closing and close-fitting covers should be provided for seat

SANITARY PRIVY

PIT TYPE **VAULT TYPE**



All boarding to be 1 inch thick, studs and joists to be 2 x 4 inches except where shown.

All openings to be screened and made fly proof.

A weight and pulley or spring to be used to close door.

openings. The building and pit should be ventilated and the vents screened. Either natural or artificial lighting is desirable.

Odors are commonly a problem in privies. Because of the usual method of construction, chemicals are not of much assistance in controlling odors. It is preferable to cover the wastes frequently and experience suggests that wood ashes are useful for this purpose. Chlorinated lime is often used. Several commercial products are available for odor control.

Another type of privy, which is commonly used when night soil collection and disposal service is available, is provided with small watertight receptacles to receive the wastes. It is often used in the vicinity of cities and is not so likely to contaminate nearby wells. This will include the vault type pit illustrated on page 5.

CHEMICAL TOILET

The chemical toilet is similar to the privy mentioned above but differs in that a chemical is used to dissolve the solid wastes. Caustic soda, dissolved in water, is a commonly used material in the chemical toilet. A metal pail or, in larger installations, a metal tank is used as the receptacle and the contents are removed from time to time and buried in a location remote from water supplies. Frequent renewal of the chemical is required if odors are to be controlled. When the necessary care is observed in maintenance, a chemical toilet will provide a reasonably good method of waste disposal.

SEPTIC TOILET

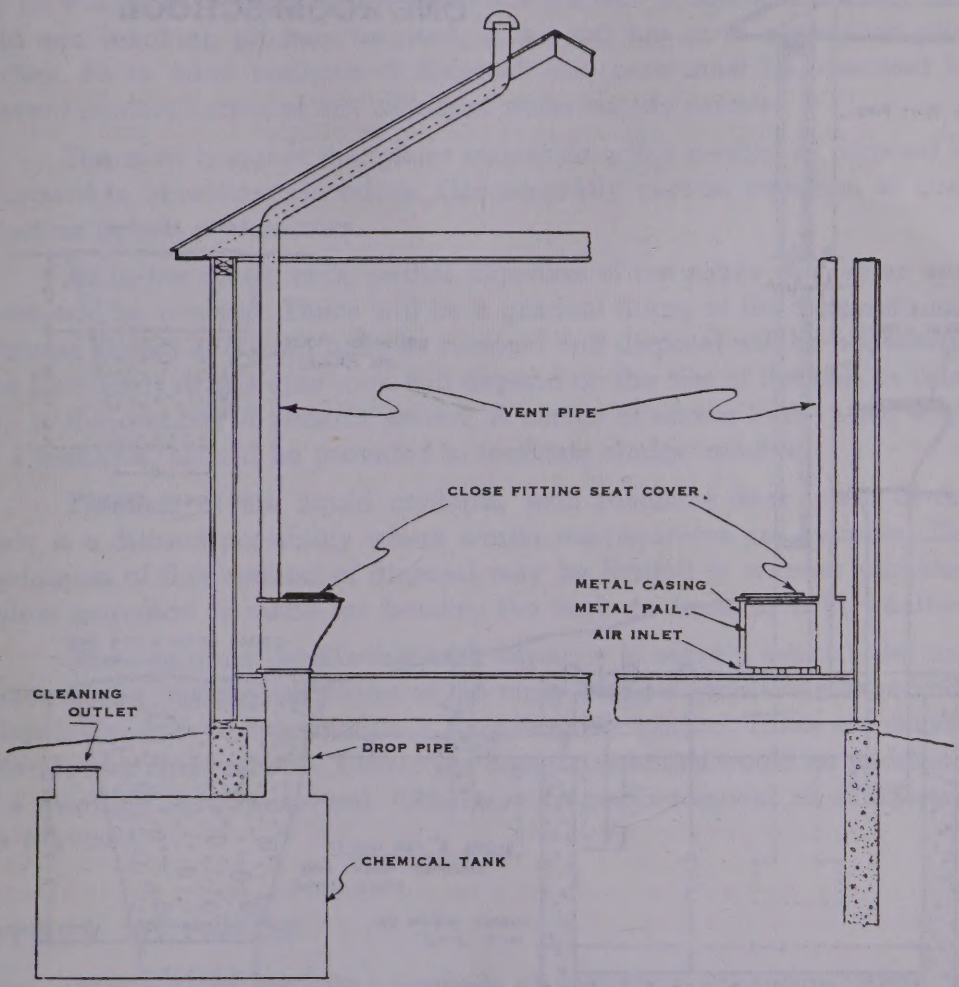
The septic toilet, as it is commonly named, is an adaptation of the septic tank which will be described in detail later. It serves where only a limited volume of water is available. Although it is a fairly recent development, its use is increasing, particularly for rural schools and small institutions. It can also be used for a family dwelling. Reports concerning the suitability of this method of disposal vary a good deal but are more favorable than otherwise.

It is customary to construct a watertight tank, preferably of concrete for durability, with one end of the tank located directly below the toilet. The toilet has a straight drop pipe of sufficient diameter to reduce the possibility of fouling its surface. It extends below the water level in the receiving tank, thus minimizing the likelihood of odors from the tank escaping into the toilet room.

The tank is filled with water prior to being placed in service. An outlet pipe conveys the overflow to a disposal tile bed or leaching pit. This outlet is located about one foot below the tank top and to prevent the escape of solid wastes such as scum, a baffle is located in front of the outlet or the outlet is formed by a T pipe which extends some twelve to fifteen inches below the water level.

CHEMICAL TOILETS

TANK TYPE **PAIL TYPE**



ESSENTIALS FOR A CHEMICAL TOILET

A specially made toilet.

A metal tank.

An arrangement so that the contents of the tank can be stirred occasionally.

A chemical — caustic soda.

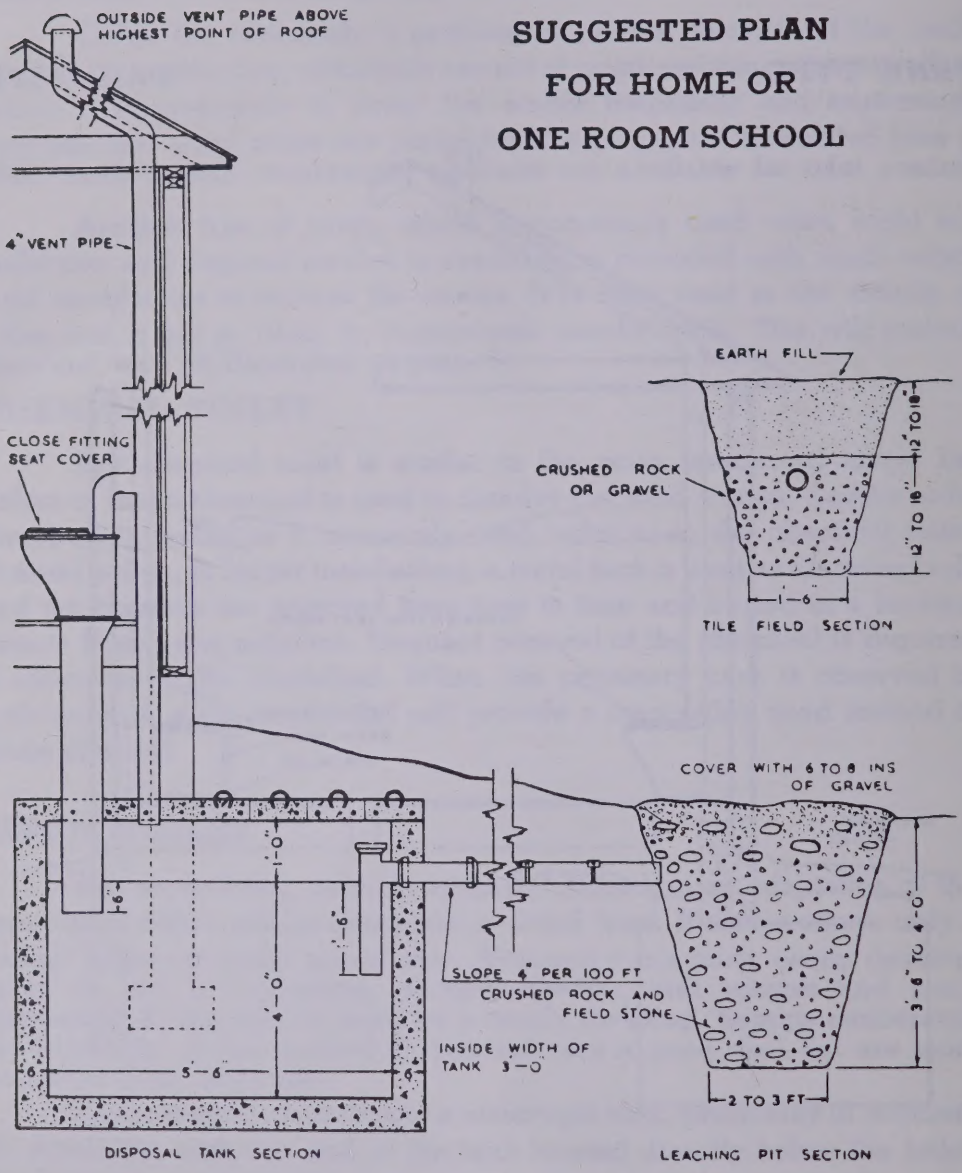
A ventilating system.

No water or sink waste to be put in tank.

Tank requires cleaning about every six months.

SEPTIC TOILET

SUGGESTED PLAN FOR HOME OR ONE ROOM SCHOOL



For disposal bed use 50 to 100 weeping tile or a combination of weeping tile and leaching pit as shown. Use 4 inch V.C. tile with cemented joints for a distance of 15 to 20 feet from the house.

Outside top cover slabs to be poured separately — 11 inches wide with two ½ inch diameter reinforcing rods 7 inches center to center. Provide handles for lifting.

Fill tank with water before using. Add a pail of water per day when tank is in use. Remove the sludge from tank before it reaches a maximum depth of 2 feet.

A vent is provided at the rear of the toilet seat to carry away odors and this vent extends to the outside air, preferably through the roof of the building.

In operation, a pailful of water is added daily to the tank, hence the outflow of liquid is very small and a relatively small disposal area or leaching pit will serve to disperse this waste into the soil. A combination disposal field and leaching pit may be used, if the soil has poor absorption properties. As in other methods of disposal, due care must be observed to prevent contamination of any adjacent water supply sources.

The most frequent complaint concerning this method of disposal is in regard to objectionable odors. Consequently careful attention to construction details is necessary.

As in the septic tank, partial digestion of the solids will occur and gases will be evolved. There will be a gradual filling of the tank with undigested sludge and eventually its removal and disposal will be necessary. The frequency of this operation will depend on the size of the tank in relation to the number of persons served. A means of access to the tank, such as a manhole, should be provided to facilitate sludge removal.

Freezing of the liquid contents, with resultant destruction of the tank, is a distinct possibility where winter temperatures are extreme. The usefulness of this method of disposal may be limited to warmer climates, unless provision is made for heating the tank contents in cold weather.

The minimum permissible tank capacity to serve a septic toilet unit has not been determined. Some of the tanks being offered for sale provide a liquid capacity of approximately 10 gallons per person. These are usually intended for rural schools. Larger per capita capacities would be necessary if a dwelling is to be served. Otherwise frequent removal of sludge will be required.

OTHER METHODS

While there are other methods of disposing of excreta, when the water supply is limited in quantity, such as the "bore-hole" latrine and cremating latrine, none of these appears to warrant consideration, except under unusual conditions.

SEPTIC TANK

Where water under pressure is available but it is impossible or too costly to connect the building sewer to a public sewerage system, it is necessary to arrange for a means of waste disposal which can be provided in a comparatively small area. The system most commonly used is a septic tank with a tile disposal bed. This achieves two results, (a) a reduction in

the volume of solids which require final disposal and (b) the dispersal of the liquid effluent, chiefly by absorption into the soil.

When properly designed and correctly installed, the septic tank system will usually function satisfactorily with a moderate amount of attention. Certain features, as in other methods of excreta disposal, require special care and the protection of local water supplies is probably the most important. Disease-causing bacteria are not destroyed in the septic tank and, consequently, the liquid effluent will dangerously contaminate any water into which it is discharged. Seepage through the ground may remove the bacteria by the filtering action of the soil, or may slow down the flow so that the bacteria will die out before the effluent reaches a source of water.

As in other methods of disposal, special care is required where the subsoil consists of coarse gravel or fissured rock such as limestone. In such areas, it may be necessary to take special precautions in the construction of the sewage disposal system and of the well. Under very adverse conditions, it may be necessary to provide a watertight sewer to conduct the sewage to a remote area.

SEPTIC TANK ACTION

The disposal of sewage by digestion, under septic conditions in a watertight tank, has been practiced for a long time. In spite of this, it is only recently that careful research has been carried out to determine some of the factors which affect the operation of a septic tank.

Two materials are commonly used in constructing septic tanks. Ready-made units are of steel. Tanks constructed in place are usually made of concrete.

The steel tank has two shortcomings, (a) it is frequently too small for the service required and (b) its probable service is limited to from seven to ten years because of corrosion, and replacement will then be necessary. Consequently, it is usually recommended only for short-term service where a sewerage system will probably be installed before replacement of the tank is required.

For installations which are likely to be used for a considerable number of years, a tank constructed of concrete is usually recommended. A suggested design is contained herein and other suggested designs are available from some provincial health departments. While these differ in regard to some details, the general requirements are quite similar.

Canadian officials who are responsible for the control of sewage disposal units are generally agreed that the septic tank should have a capacity of at least 400 Imperial gallons. Experiments carried out by the

Environmental Health Center of the United States Public Health Service at Cincinnati, Ohio., indicate that the minimum capacity should be 500 U.S. gallons. (N.B. These figures are for septic tanks which are intended to serve one family only, and increased capacity must be provided when more persons are to be served, see page 12). Tanks with larger capacities per capita have the advantage that less frequent removal of sludge is required. Since sludge removal is a phase of operations most frequently neglected, there would appear to be valid reasons for installing tanks of larger capacity. Experiments have indicated that tanks with two or three chambers, in series, will give better results than single chamber tanks, but it is unlikely that the added cost would be justified for small installations.

The inlet of a septic tank is most frequently a T pipe, extending below the liquid level, or a straight pipe with a baffle across the tank about 18 inches from the inlet end, extending 12 inches below the liquid level and six inches above it. The purpose of the T or baffle is to reduce the velocity of the flow so that currents in the tank do not carry suspended solids to the outlet. A similar arrangement is commonly used for the outlet but in this instance, if a baffle is used, it should extend 18 inches below and six inches above the liquid level. The elevation of the outlet should be about two inches below the elevation of the inlet.

USE OF SIPHON

There is not complete agreement in regard to the use of a siphon and dosing chamber on household units. The purpose of the siphon is to discharge a fairly large volume of effluent at one time. Dosage chambers are usually designed to hold from one quarter to one third of the estimated daily flow. They give better distribution in the sub-surface tile bed, which is the usual method of disposal of the liquid, and provide a rest period for the disposal bed between discharges.

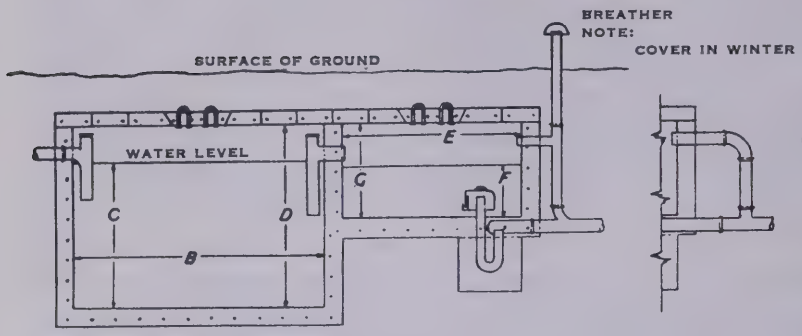
The use of a siphon is commonly recommended for cold climates, such as are experienced in most of Canada. One disadvantage in level areas is that the tile will be deeper in the ground when a siphon is used adding to the cost of construction, bringing them closer to the ground water and, not infrequently, into more impervious ground where seepage of the liquid is retarded. Where sloping ground makes it possible, the disposal tile should be laid about 18 inches below the ground surface

It is generally believed that bacterial action, which is required to carry out final purification of the sewage, is better when the disposal bed is located in surface soils. Tiles are laid on slopes of two inches to four inches per 100 feet, are spaced about $\frac{1}{4}$ inch to $\frac{1}{2}$ inch apart and tarpaper is usually placed over the top half of the openings between the tile to prevent sand or soil from gaining entry and blocking the tile. The amount of tile will depend on the number of persons served and the nature of the soil.

SEPTIC TANK DISPOSAL SYSTEM

FOR PRIVATE DWELLINGS

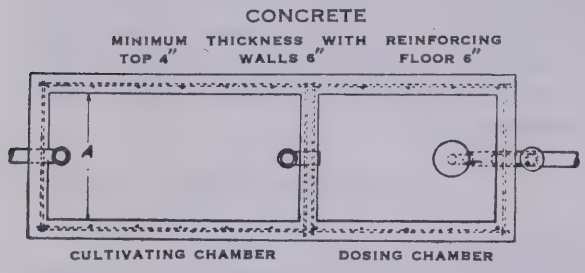
USING SIPHON



STEEL REINFORCING

TOP—½" dia. bars
1½" from interior face of concrete.

(Precast Top)—as shown
(Poured in Place)—12" center to center



WALLS—½" dia. bars.
6½" centers horizontal
15" centers vertical
2" from interior face.

FLOOR—½" dia. bars.
8" centers horizontal. both ways
2½" from exterior face

SEPTIC TANK SIZES FOR DWELLINGS

		CULTIVATING CHAMBER INSIDE DIMENSIONS				DOSING CHAMBER INSIDE DIMENSIONS				
No. of Bedrooms	No. of Persons Max.	Width Ft. Ins. A	Length Ft. Ins. B	Liquid Depth C	Total Depth D	Size of Siphon Diam.	Length Ft. Ins. E	Liquid Depth F	Total Depth G	Septictank Capacity Gallons
2 or less	5	3-0	5-6	4'-0"	5'-0"	3"	3-0	1'-5"	2'-6"	413
3	6	3-0	6-0	4'-0"	5'-0"	3"	3-6	1'-5"	2'-6"	450
4	8	3-6	7-0	4'-0"	5'-0"	3"	5-0	1'-5"	2'-7"	612
5	10	3-6	7-6	4'-6"	5'-6"	3"	5-0	1'-5"	2'-7"	740
6	12	4-0	8-0	4'-6"	5'-6"	3"	5-0	1'-5"	2'-7"	900
7	14	4-0	9-0	4'-6"	5'-6"	3"	6-0	1'-5"	2'-7"	1012
8	16	4-0	10-0	4'-6"	6'-0"	3"	7-0	1'-5"	2'-7"	1125

Siphon chamber capacities are approximate only based on average soil conditions and minimum number of field tile.

Increased capacity may be necessary to accommodate soil characteristics.

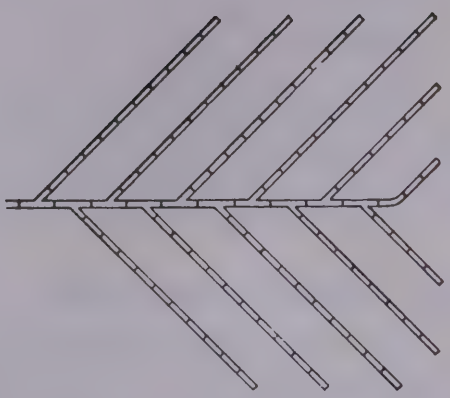
SUGGESTED LAYOUT FOR DISPOSAL FIELD

Disposal field should be a minimum distance of 100 feet from well and 25 feet from dwelling.

Minimum number of field tile — 30 per person as noted in Septic tank size table.

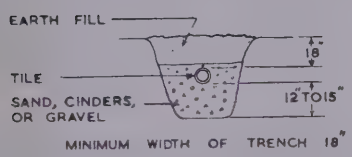
Maximum length of any line of field tile not to exceed 100 feet.

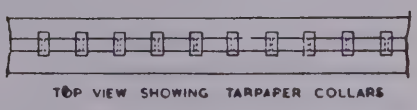
Field tile is laid with loose joints, grade not to exceed 4 inches per 100 feet. Top of joints to be covered with tar paper to prevent clogging.



A minimum distance of 3 feet is required between lines of field tile.

DISPOSAL TRENCH FOR IMPERVIOUS SOIL





NOTE

Re: Septic tank

Minimum distance between tank and domestic water supply is 50 feet.

Minimum distance between tank and building wall is 3 feet.

Remove sludge from tank at least once a year.

Prime siphon with water before tank is placed in operation.

Re: Disposal field

Use V.C. tile with tight joints for main distribution line from septic tank to disposal bed.

4 inch field tile to be laid with joints ¼ to ½ inch wide.

Gravel to be ½ to 2½ inch in size and carried to a height not less than 2 inches above tile.

Close-textured soils, such as clay, require special care. Under these conditions, the disposal tile are usually laid on gravel or crushed rock and additional tile may be necessary. The tile should be covered to a depth of two inches with the gravel or crushed rock. Tile lines are usually three to six feet apart, and should preferably not be longer than 75 feet. Extra care is required if the soil in the disposal area has been disturbed.

Local circumstances usually determine the type of sewer pipe to be used for connecting the building plumbing to the septic tank and the tank to the disposal field. Cast iron pipe with leaded joints is recommended where nearby water supplies must be protected.

COLD CLIMATE FACTORS

In extremely cold climates the tile disposal field may be replaced by a leaching pit or with a number of leaching pits in series. While freezing is not often a problem in small sewage disposal units, the leaching pit is less likely to be affected by lengthy periods of severe cold.

Where freezing has been a problem in household sewage disposal systems it has been found that they were improperly constructed or that the sewers or tile lines were located under roadways where frost penetrated easily due to removal or compacting of the snow cover. Sometimes trouble from the frost develops when a system is put into service in the late autumn, but the most important precaution necessary to avoid freezing is to keep the disposal system away from roadways. Snow fences will help to keep snow cover over the disposal system.

Leaching pits are not usually recommended, except under unusual conditions such as in extremely cold areas. Since they do not provide as much surface for the absorption of the septic tank effluent as a sub-surface tile bed, they are more likely to become clogged by solids and eventually to overflow. They are usually deeper in the ground than disposal tile and this may increase the danger of contaminating near-by water supplies.

GENERAL INFORMATION

A septic tank disposal system will give satisfactory service if its design, construction and maintenance are good. Like most pieces of equipment it does require some attention if the best results are to be obtained. When neglected the cost of correcting conditions will probably be greater than would have been required for more frequent attention.

The purpose of the septic tank is to provide an opportunity for the solids in the sewage to settle and be reduced by digestion. Thus the final disposal area is less likely to become clogged with solids. Part of the settled solids are broken down into liquid and gases by the organisms which are

naturally present in the sewage. This is referred to as "anaerobic digestion", meaning that it occurs without oxygen.

When first put into operation the contents of the septic tank will probably be slightly acid in character and the odors will be offensive. Usually this condition will change to alkaline and there will then be very little odor. Since gases are produced during the digestion process, it is necessary to provide a free space in the tank above the sewage, usually about 12 inches deep. Provision should also be made for the escape of the gases. Frequently these are allowed to escape through the plumbing stack of the building or a vent may be provided on the tank, or on the outlet sewer close to the tank.

DIGESTION PROCESS AND CARE OF TANK

There is a widespread belief that something must be added to a septic tank, when it is first put into operation to "start it." This is not true. The anaerobic digestion will develop automatically, because the necessary organisms are present in the sewage and the design of the tank creates the required conditions. The onset of digestion may be accelerated, however, and the best known material for this purpose is a few gallons of "ripe" sludge, from a septic tank which is operating properly. Yeast is frequently used, but experiments have shown that it has no particular value for this purpose.

Another false idea is that all the solids are digested in the tank. Because a good deal of the sludge is never digested, the remainder accumulates. Usually, however, after a certain volume is deposited, solids are carried away by the tank effluent as fast as they are added to the tank and this may result in a clogged disposal field. This condition may become so bad that a new disposal field must be constructed. Consequently accumulated sludge must be removed from time to time. The frequency of removal depends on the capacity of the tank in relation to the number of persons served. It is not necessary or desirable to remove all the sludge when a tank is cleaned.

Because septic tanks are so widely used and because owners are inclined to neglect them, there is a demand for a simple method of cleaning them which will avoid the necessity of removing sludge. Most of the products offered on the market are strong caustics, such as caustic soda. If added to the tank in sufficient quantity, they will dissolve the solids. At the same time they will destroy the active organisms and stop the digestion process. Their effects on the disposal field are belived to be harmful.

Since it is not possible to have information about all available products, it cannot be said that none has value. However, the septic tank owner is cautioned to use these products with care and preferably only

when they are endorsed by health officials who are familiar with their effects on the continued operation of the unit. Costs, as compared with sludge removal, are also a factor requiring consideration

OTHER RELATED FACTORS

At one time it was considered good practice to install a grease trap on kitchen wastes, so that grease could be kept out of the septic tank. This practice has been abandoned in most areas for small disposal units. However, some authorities still recommend them for large restaurants or camp kitchens, where considerable quantities of grease may be wasted.

Laundry wastes were also regarded as harmful, as well as cleaners and solvents used in kitchen and bathroom. There now appears to be no need for by-passing the septic tank with such wastes if the tank is as large as recommended. With the increasing use of household water softeners, consideration should be given to by-passing the wastes when these units are regenerated in the home.

While garbage grinders are not commonly used on Canadian plumbing systems, a house equipped with one should have a septic tank with 50 per cent additional capacity.

When a septic tank serves a summer home, it is advisable to empty it in the autumn to prevent destruction of the tank by freezing of the contents.

For units serving schools, electric immersion heaters may be used to advantage over week-ends when the absence of added heat might result in freezing.

Roof, basement and foundation drains should not be connected to the sewage disposal system.

Occasionally it may be necessary to provide under-drainage for a tile disposal bed. Ditches constructed near the field can be used to advantage to intercept surface run-off and lower the water table.

Roots of deciduous trees sometimes cause trouble by blocking the disposal tile. This possibility should be considered when locating the disposal bed.

Percolation tests may be used to estimate the approximate length of disposal tile required. Instructions for making the test are available on request.

To insure satisfactory operation, the tank and disposal bed should be examined by a qualified person before it is covered with soil.

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